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Integral role of natural farming in fostering circular economy: A review

YB Vala, CK Patel, MH Chavda, MG Chaudhary and HR Gothi

Abstract

In India, the agriculture sector has been dominated for the past over 40 years by Green Revolution. Now a day using conventional techniques in agriculture is like cancer to our soil. Conventional agriculture expeditiously promotes productivity and yield but for the time being, it shows its consequences such as over usage of natural resources and disturbs the agricultural environment. Stepping towards the sustainable development goals, circular economy has become the most efficient way all over the world, as it establishes the importance of sustainable agriculture and food production systems constantly by providing various possible solutions and use of nominal additional inputs. It does not only make the soil barren but eventually, the farmers goes under debt. A revolutionary impact of green revolution that broke away the old and outdated traditional practices. Green revolution has left bad footprints on country's food security and environmental safety. Hence, the only way to deal with this ever-rising problem is Natural Farming. Natural Farming is one such low-input, climate-resilient farming that inspires farmers to use low-cost and locally sourced and available inputs, eliminating the use of artificial/chemical fertilizers and industrial pesticides. There are most popular four pillars of Natural farming i.e. *Jeevamrut*, *Beejamrut*, *Acchadan* and *Whapasa*. Natural product made from farm resources utilized for nutrition, food safety and plant protection purpose, which helps the farmers to find other alternative method of natural farming especially for their self-reliance (Atmanirbhar) and circular economy.

Keywords: Natural farming, green revolution, agriculture, farmers, food security, Atmanirbhar, circular economy

Introduction

Agriculture is an important sector in India. It is indispensable for the sustenance and growth of the Indian economy. On an average half, the country's population today depends on agriculture and allied services for their livelihoods. Green Revolution transformed the country from a food-deficit state to self-sufficiency during early 1970s. Now Indian farmers increasingly find themselves in a vicious cycle of debt, because of the high production costs, high interest rates for credit, the volatile market prices of crops, the rising costs of fossil fuel-based inputs and costly seeds. While the country has been planning to revamp its agricultural production system including research and development to meet this formidable challenge, the economic survey of 2018-19 made keen appeal for adoption of Natural Farming in a big way to double farmer's income and the Hon'ble Prime minister subsequently endorsed it.

The neoliberalization of the Indian economy led to a deep agrarian crisis that is making small scale farming an unviable vocation. Privatized seeds, inputs, and markets are inaccessible and expensive for peasants. Indian farmers increasingly find themselves in a vicious cycle of debt, because of the high production costs, high interest rate of credit, the volatile market price of crops, the rising costs of fuel based inputs and private seeds. More than a quarter of million farmers have committed suicides due to debt. It is a problem for farmers across India. This creates a serious problem in the Agriculture industry. Natural Farming, as the name implies, is a method of farming where the cost of growing and harvesting plants is minimum to minimum or nil. This means that farmers need not purchase fertilizers and pesticides in order to ensure the healthy growth of crops. All inputs are to be locally resourced from the farm or around the village. Natural Farming is one such low-input, climate-resilient farming that inspires farmers to use low-cost and locally sourced and available inputs, eliminating the use of artificial/chemical fertilizers and industrial pesticides.

Natural Farming



Fig 1: Social, ecological and economic attributes of natural farming

Sustainable agriculture is the practice of farming using principles of ecology and it integrates three main goals – Environmental (environmental health), Social (social and economic equity) and Economic (economic profitability).

Natural farming aims to increase farmer's yield by maximizing production factors (labor, soil, equipment) and by avoiding the use of non-natural inputs (fertilizer, herbicides and pesticides) to optimize production potential and thus provide abundant, high quality, healthy food at the best price. The golden rule is to enrich the level of organic matter into the soil, which supports microbial life, and therefore the soil's fertility. Conventional farming, on the other hand, does not aim to optimize yields using inputs, which requires extensive cultivation over larger areas to produce the desired quantities. Thus, such farming has the blessing of all those who dream of a world where "Mother Nature" would overthrow technical progress, is nonetheless responsible for one of the greatest tragedies for biodiversity: the disappearance of millions of acres of forest. An excessive use of chemical inputs can produce harmful effects. Natural farming aims at improving and preserving the quality of soil, whereas in every case conventional farming destroys. The important step in natural farming are conservation of crop diversity, no tillage, watershed management, efficient water management, integrated nutrient management, integrated weed management, integrated pest management and crop diversification.

Circular economy and its relation to Agriculture

According to the World Economic Forum's Definition of Circular Economy, "It is an integrated system of steps to ensure the least natural resource input and waste disposal, also

aimed at restoration, use of renewable resources, elimination of toxic chemicals, and reduction of pollution. It depends on the 3 R's of the circular economy namely, Reduce, Reuse and Recycle. The "Circular Economy" approach to waste diversion is often best demonstrated by organic farming practices. They support common frameworks of recovery and waste just doesn't exist as it spins through the framework to finish the Circular Economy cycle.

Reduce 2) Reuse and 3) Recycle

Reduce: To attain sustainability and to maintain a healthy environment in the long run, it is very important to bring down the extensively used agricultural inputs which cause soil and water pollution and other environmental degradation. This should be replaced with the incorporation of minimal inputs which are eco-friendly i.e., biofertilizers.

Reuse: Some non-renewable resources like water can be used multiple times. Water used for domestic and industrial purposes is subjected to different types of treatments and can be reused for crop irrigation in fields. Water used for washing livestock can be used for irrigation as well. This practice helps in watering and fertilizing the crop and avoids the release of sewage to water bodies.

Recycle: Recycling is the reusing of a particular product after completing its primary function. Recycling happens at various places including fields, homes, communities, etc.

Atmanirbhar Krishi and Atmanirbhar Kisan

Atmanirbhar Krishi and Atmanirbhar Kisan are important to achieve the goal of Atmanirbhar Bharat – hon Prime Minister

Shri Narendra Modi, in his address to the Nation on the 74th Independence Day, New delhi. Despite lockdowns due to Covid-19 pandemic, only agricultural sector has performed better with 2.9% growth rate during 2019-20, as against 2.7% during 2018-19.

- Promoting integrated farming along with natural and organic farming is vital for Atmanirbhar Bharat Abhiyan - Shri Narendra Singh Tomar in Virtual 26th Meeting of ICAR Zonal Committee 30th June, 2020, *Krishi Bhawan, New Delhi*.
- Natural Farming is only one way to get immunity against covid-19 and make atmanirbhar kisan in atmanirbhar bharat - Shri Acharya devvrat (Guj governer).

Salient Features of Natural farming

- Protecting soil fertility and soil health
- Maintaining the level of organic matter
- Encouraging biological activity in soils
- Providing nutrients through the microbial action
- Using legumes to fulfill the nitrogen requirements of the soil.
- Recycling organic matter like crop residues and manures
- Managing diseases, pests and weeds using techniques like natural predators, organic manuring, crop rotation, maintaining diversity, growing resistant varieties, etc.
- Effective livestock management by paying special attention to their nutrient requirements, housing, breeding, rearing, etc.

Implementing States of Natural Farming

1. Haryana – 80 acres in Gurukul, Kurukshetra
2. Punjab – 1000 acres
3. Karnataka – 10 Agro climate zones
4. Andhra Pradesh – 5.01 lakh acres
5. Himachal Pradesh – Across the state

How in Natural farming we need no fertilizers?

- *Bhumi Annapurna*: Means soil is rich with all nutrients for plants to grow.
- We should take only those we use and leave the rest from the crops to soil itself.
- Stop completely removing crop and burning down the crop remains.
- *Jeevamrut* 200 liters per acre per month is enough as a culture to convert the soil.

Why no need for weeding in Natural farming?

- Mulching in the field will stop the growth of weeds.
- Inter crops will replace the growth of weeds.
- Weeds are used for enriching the soil components.
- Plants do not compete for the food. They coexist and live in symbiosis.

Why we do not need pesticides and anti-infectants in Natural farming?

- Pests and infections will not come to infect a healthy crop.
- Even if infected, the healthy plant can have immunity to withstand their effect.
- Natural pest controls in the form of complementary crops and *Asthra*s will help.
- Use of *desi* seeds strengthen the crops.

Methodology for Natural farming

JIVAMRITA / <i>Jivamrut</i>	BIJAMRITA / <i>Bijamrut</i>	ACCHADAN / Mulching	WHAPASA / Moisture
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Natural farming has main four pillars as mentioned in Table 1.

Table 1: Natural farming has main four pillars as mentioned

Sr. No.	Methods	Preparation	Benefits
1.	<i>Jivamrita/ Jeevamrut</i>	It is composed of the cow-dung (20 kg), cow urine (5-10 lit), jaggery (20 kg) and dicot flour (2 kg) and is applied to the crops with each Irrigation cycle OR directly to the crops.	It provides nutrients, but most importantly, acts as a catalytic agent that promotes the activity of microorganisms in the soil, as well as increases earthworm activity. <i>Jeevamrut</i> also helps to prevent fungal and bacterial plant diseases. <i>Jeevamrut</i> is needed for the first 3 years of the transition, after which the system becomes self-sustaining.
2.	<i>Bijamrita/ Beejamrut</i>	It is made up of water (20 lit), cow dung (5 kg), cow urine (5 lit), lime (50 gm) and just a handful of <i>sajiv</i> soil.	It is used for seed treatment, protecting young roots from fungus as well as from soil and seed-borne diseases.
3.	<i>Acchadana/ Mulching</i>	It can be done by soil mulch, straw mulch or live mulch.	It conserves soil moisture, by reducing evaporation.
4.	<i>Whapasa/Moisture</i>	The irrigation should be reduced and irrigation should be practiced at noon in alternate furrows.	It is condition where air molecules and water molecules present in soil. Mixture of 50% air and 50% water vapours in the cavities between two soil particles.

Table 2: Different *Asthra*s for pest management in Natural farming

Sr. No.	Name of pest Management formulae methods	Composition	Benefits
1.	<i>Agniastra</i>	It composed of 20 litres Local cow urine, 500 gm Tobacco, 500 gm of Green Chilli, 500gm of Local Garlic, 5kg Neem leaves pulp (crushed in urine). For 1acre spraying, 6-8 litres <i>Agniastra</i> left after boiling is taken in 200 litres water.	It is effective against the pests like leaf roller, stem borer, fruit borer, and pod borer.
2.	<i>Brahmastra</i>	It composed of 10 lit local cow urine, 5 kg Neem leaves, Guava, Mango, Neem and Castor (<i>Eranda</i>) leaves pulp crushed (2-2 kg each). It is prepared by crushed and boiled in <i>desi</i> cow urine. For 1acre 2.5-3 litres solution mix in 200 lit water and used as spray.	It is used to control all of sucking pests, fruit borer, and pod borer.

3.	<i>Neemastra</i>	It is made up of local cow urine (5 litres), cow dung (5 kg) and neem leaves (5 kg) water (100 litres). It is prepared by mixing all materials and use after 48-72 hours for 1 acre.	It is used for sucking pests and mealy bug.
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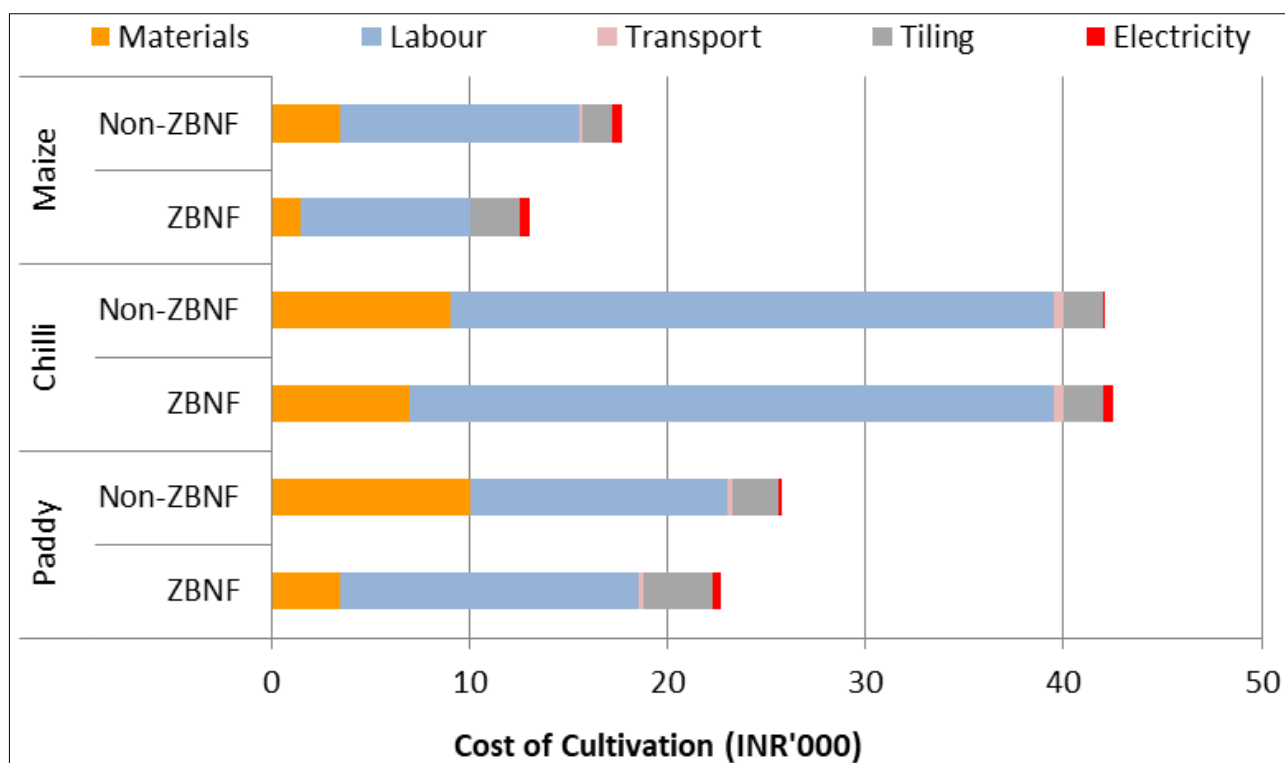
Table 3: Cow based natural farming practice for poor and small land holding farmers

Pesticides / Fungicides	Use
<i>Neemastra</i>	To control sucking pests and small insects
<i>Agniastra</i>	To control borers, caterpillars
<i>Brahmastra</i>	To control leaves eating larvae
Fermented buttermilk	To avoid and control all type of spots on leaves and fruits etc.
Asafoetida decoction	To avoid and control bacterial diseases and best used for paddy sheath blight.

Research findings related to LBNF

Natural Farming aims to drastically cut down production costs by encouraging farmers to prepare essential nutrients and plant protection materials with locally available resources, thereby ending the need for external and commercial inputs like fertilizers and other chemicals. The inputs like *Jivamrut* and *Beejamrit* are significantly reducing the costs of cultivation.

As per the report of Centre for Study of Science, Technology and Policy in Andhra Pradesh on ‘Life Cycle Assessment of Natural Farming (NF) and Non-NF’, fertilizer’s contribution to materials cost is 10%–20% in NF *viz-a-viz* 50%–70% in non-NF Overall of cost of cultivation is lower in NF than in non-NF for paddy, maize, and groundnut (refer to below figure).

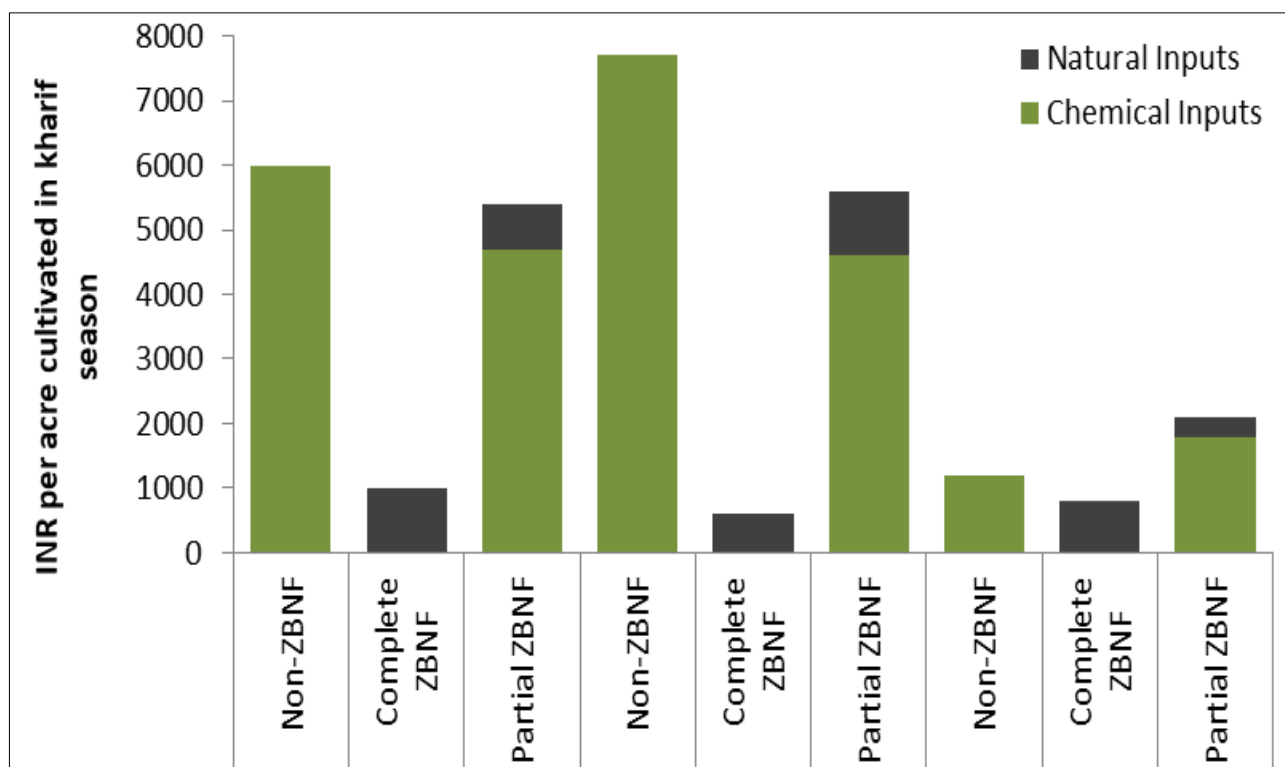


Source: CSTEP (2020) Life cycle assessment of NF – Non NF: A Preliminary study in Andhra Pradesh

Fig 1: Cost of cultivation in irrigated crops

Recent studies have observed that farmers cultivating rice using chemical inputs spend INR 5,961 per acre on average, while one using NF techniques incurred INR 846 per acre on natural inputs. A similar pattern has been observed with respect to maize and groundnut cultivation. For maize, NF

farmers spent INR 503 per acre on natural inputs whereas chemical farmers, on average, spent INR 7,509 per acre. For groundnut, a chemical farmer spent INR 1,187 per acre as against INR 780 per acre by a NF farmer.



Source: Can Zero Budget Natural Farming Save Input Costs and Fertiliser Subsidies? Evidence from Andhra Pradesh- Niti Gupta, Saurabh Tripathi, and Hem H. Dholakia- CEEW Report January 2020

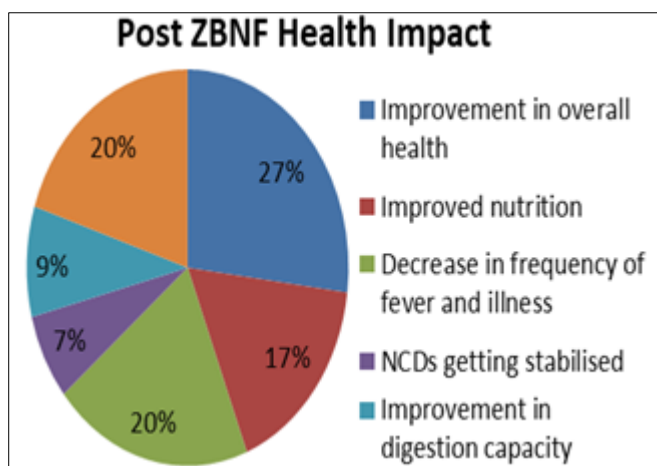
Fig 2: Average input cost on fertilizers and pesticides drops significantly for NF rice and maize farmers

Fertilizers and pesticides have been shown to have adverse impacts on farmers as well as consumers. Farmers are exposed to contaminants while applying chemical inputs. By replacing such external inputs with locally made natural concoctions, inoculums, and decoctions, NF can reduce the incidence of non-communicable diseases, such as acute and chronic neurotoxicity, respiratory diseases and even cancer, which are associated with the use and application of inorganic chemicals in agriculture. Pesticides contain endocrine-disrupting chemicals (EDCs), which enter humans through diet and can have negative health impacts such as breast cancer, reproductive disorders, and poorer intellectual development in children. Discontinuing chemical pesticides and fertilizers in fields will prevent run-off into water sources, further reducing communities' exposure to such chemicals.

Natural Farming products have a much higher nutritional content. Protein, amino acid, crude fat and other essential nutrient were about 300% higher than ordinary products. Chemical residue such as nitrate is almost undetectable in Natural Farming produce. A research study on 'Assessment of Post NF effects on the Health and Nutrition Profile of Households' through interviewing 570 households spread across 8 pilot districts and 19 clusters of Andhra Pradesh revealed that almost 80% of the NF families have experienced improvement in gastric problems, Hypertension and Diabetes post NF consumption. All the NF households revealed improvement in stamina and improvement of health in their infant's post NF consumption.

Environmental conservation through LBNF

Over the past 50 years, greenhouse gas (GHG) emissions resulting from 'Agriculture, Forestry and Other Land Use' (AFOLU) have nearly doubled, and projections suggest a further increase by 2050 (Tubiello *et al.*, 2014) [32]. The largest share of global methane and nitrous oxide emissions is contributed by Agriculture as per the studies of FAO. Excessive use of fertilizers in conventional farming has significantly contributed to global greenhouse gas (GHG) emissions and climate change. The number of greenhouse gases (GHGs) emitted per nutrient ton of fertilizer produced is 1.1 metric tons of CO₂/nutrient ton in 2016. The climate change will have an impact on global food security and may affect the nutritional properties of some crops. Under conditions of elevated levels of carbon dioxide, the concentrations of minerals in some crops (e.g., wheat, rice and soybeans) can be up to 8 percent lower than normal. Protein concentrations may also be lower, while carbohydrates are higher (FAO, 2015). A meta-analysis of 1090 studies on yields (primarily wheat, maize, rice and



Source: Assessment of Post NF effects on the Health & Nutrition profile of households (December 2019)

Fig 3: Perception of HHs on Health post NF consumption

soybeans) under different climate change conditions indicates that climate change may significantly reduce yields in the long run.

Natural Farming aims to reduce risks associated with uncertainties of climate change by promoting the adoption of an agroecology framework. It encourages farmers to use low-cost homegrown inputs, eliminate the use of chemical fertilizers, and industrial pesticides. Natural Farming has shown evidence of increased resilience of farmlands along with protecting crops against extreme weather conditions by improving the fertility and strength of the soil.

Natural Farming fields / crops / orchards show especially strong resistance to climatic fluctuation. During the Pethai and Titli cyclones of 2018, the crops cultivated through Natural Farming in Andhra Pradesh, showed greater resilience to heavy winds than conventional crops. A study by CEEW on “Zero Budget Natural Farming for the Sustainable Development Goals Andhra Pradesh, India”, observed that during a bout of cyclonic winds in Vishakhapatnam in 2017, paddy crops withstood the winds and water-logging much better than adjacent non-NF (Zero-Budget Natural Farming) paddy fields. This aspect would help minimize the revenue losses to the farmer due to adverse climatic conditions.

Similarly, the CSE study on “State of Organic and Natural Farming in India- challenges and opportunities” also states that most farmers felt that NF had improved the overall resilience of crops to adverse climatic conditions.

Government Schemes and Initiatives to Support Natural Farming

- In the context of the government’s commitment to double farmers’ income by 2022, GOI is promoting natural farming in country through dedicated schemes of Paramparagat Krishi Vikas Yojana (PKVY) and through Rashtriya Krishi Vikas Yojana (RKVY).
- NITI AYOJ in a survey found out that the Zero Budget technique has resulted in an increase in the yields of crops like cotton by 11 per cent, paddy by 12 per cent, groundnut 23 per cent, and chilli 34 per cent at less than half the cost of cultivation in the year 2016-17.
- Addressing the United Nations conference on desertification (COP-14), our honorable Prime minister told the global community that India is focusing on Zero Budget Natural Farming (ZBNF).
- Finance Minister Nirmala Sitharaman has often mentioned how ZBNF will double farmers’ income by going “back to basics” in her budget speech.
- AP Government has decided to approach 60 lakh (6 million) farming households to adopt “Climate Resilient Zero Budget Natural Farming (CRBZBNF)” as a farming practice that believes in natural growth of crops without supplying any other external inputs.

Conclusion

There are various contrasting perceptions towards Natural farming, but there is a vigorous unanimity on its eco-friendly nature and ability to maintain soil and human health. Also, many studies have disclosed that Natural farming is productive and, as it puts the accent on wise use of resources, ecological as well as economical protection, soil as well as human health and food safety to the greatest extent and acknowledges the concept of the circular economy. Hence, there is a need in spreading awareness about various Natural

farming practices among farmers and the government should take up initiatives to train and inculcate knowledge and awareness to attain a circular agricultural economy.

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